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Final

Supplemental Investigation Work Plan
Site 69, Operable Unit No. 14

Marine Corps Base, Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0223

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Acronyms and Abbreviations

Baker	Baker Environmental, Inc.
CAIS	Chemical Agent Identification Set
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Chain-of-Custody
COPC	Contaminant of Potential Concern
CTO	Contract Task Order
CWM	Chemical Warfare Materiel
DoN	United States Department of the Navy
DOT	Department of Transportation
DQO	Data Quality Objective
ERA	Ecological Risk Assessment
FFA	Federal Facilities Agreement
FS	Feasibility Study
ft bgs	feet below ground surface
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
I.D.	Inner Diameter
IDW	Investigation-derived Waste
IR	Installation Restoration
IROD	Interim Record of Decision
LTM	Long-Term Monitoring
MCB	Marine Corps Base
MNA	Monitored Natural Attenuation
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	mean sea level
NAA	Natural Attenuation Assessment
NAE	Natural Attenuation Evaluation
NAIP	Natural Attenuation Indicator Parameter
NAVFAC	Naval Facilities Engineering Command, Atlantic Division
NCDENR	North Carolina Department of Environment and Natural Resources
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NTU	Nephelometric Turbidity Unit

O.D.	Outer Diameter
ORP	Oxidation-Reduction Potential
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PID	Photo-Ionization Detector
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/ Quality Control
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WQP	Water Quality Parameter

SECTION 1

Introduction

This Site-Specific Work Plan presents the strategy and technical approach for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Supplemental Investigation under the Installation Restoration (IR) program at Operable Unit (OU) 14, Site 69 – Rifle Range Chemical Dump at Marine Corps Base (MCB) Camp Lejeune, North Carolina (the Base). A general location/index map of the Base showing the location of Site 69 is provided as **Figure 1-1**.

This Site-Specific Work Plan was prepared by CH2M HILL under Contract Task Order (CTO) 0105 of the Department of the Navy's (DoN's) Comprehensive Long-Term Environmental Action Navy (CLEAN) Program. CH2M HILL is responsible for implementation of this project. It should be noted that this Site-Specific Work Plan is to be used in conjunction with the Master Project Plans, which include the Master Work Plan, Master Quality Assurance Project Plan (QAPP), and Master Health and Safety Plan (HASP) (CH2M HILL, 2005). The Master Project Plans will be referenced to the greatest extent possible.

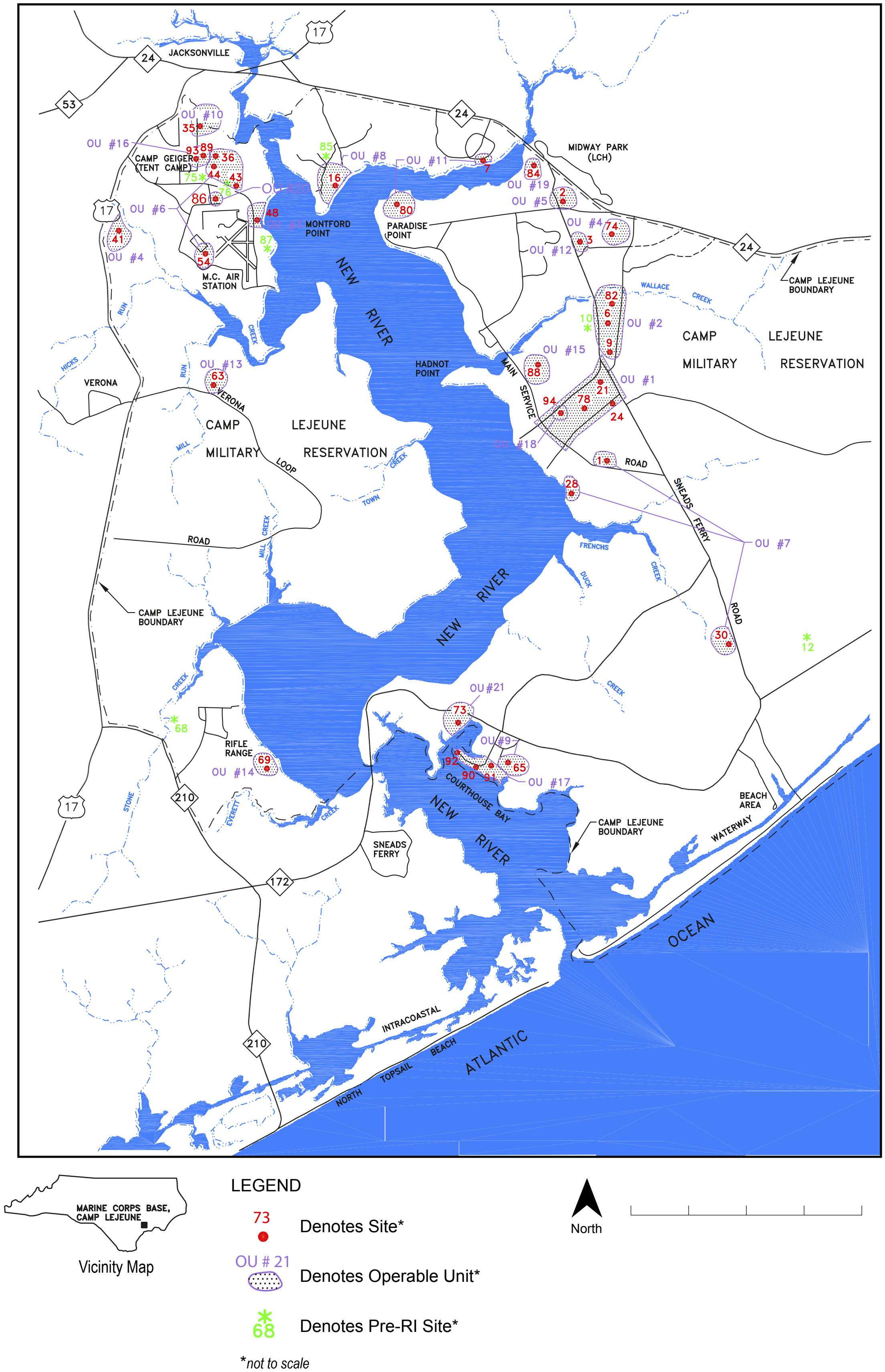

Figure 1-1
Base Map with Site 69 and Adjacent IR Sites
MCB Camp Lejeune, North Carolina

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SECTION 2

Background Information

Background information for the Base, including location, topography, geology, and CERCLA-related history, is presented in the Master Work Plan and is not repeated herein. Site-specific background information for Site 69 is presented below.

2.1 Site Description

Site 69, the Rifle Range Chemical Dump, is located west of the New River. The Site is approximately 14 acres and is situated in a topographically high area. The area is overgrown to the point that the boundary of the former dump is not easily discernable (Figure 2-1). In the 1980s, a six-foot high chain link fence was erected around the site to prevent access by trespassers and military personnel. The site is rather secluded; however, training exercises are conducted throughout the surrounding area. Three surface water bodies are located within a quarter mile of the site: the New River to the east, an unnamed tributary of the New River to the north, and Everett Creek to the south.

2.2 Site Operational History

From 1950 to 1976, Site 69 was used for the trench disposal of chemical wastes, including polychlorinated biphenyls (PCBs), solvents, and pesticides. The Site also has a reported history of chemical warfare material (CWM) disposal in the form of 50 to 60 drums containing mustard or nerve agent. Chemical Agent Detector Kits, similar to the M18A2, have been observed at the site and has led to speculation potential presence of Chemical Agent Identification Sets (CAIS), e.g. K941 or K951. However no physical evidence to support the presence of CAIS has been discovered.

2.3 Previous Site Investigations and Remedial Actions

During the Initial Assessment Study (Water & Air Research, Inc., 1983) conducted at MCB Camp Lejeune, Site 69 was one of 76 sites identified as “potentially contaminated” and one of 23 sites warranting further investigation.

Investigations conducted at Site 69 to date have focused on non-CWM contaminants based on historic disposal and chemical wastes at the site. Monitoring for CWM was performed during all intrusive activities for health and safety reasons, but no CWM was ever detected.

From 1984 to 1986, ESE performed a Confirmation Study of Site 69, which included installation of eight monitoring wells (69-GW01 through 69-GW08), collection of groundwater from the eight wells, and collection of three surface water and two sediment samples.

In 1990, a chain link fence was erected to restrict access to the disposal area. However, review of historical aerial photography, specifically from 1964, suggests that an area of disposal may lie to the north of the fenced area.

In 1991, ESE conducted a Supplemental Characterization, which included the collection of eight groundwater samples, seven surface water samples, and seven sediment samples. The results of these studies revealed that shallow groundwater exhibited elevated levels of volatile organic compounds (VOCs) in the southern portion of the site. Surface water samples obtained from on-site standing water in low-lying areas of the site revealed the same constituents as were detected in shallow groundwater, but at much lower concentrations (ESE, 1992).

From January 1994 through April 1996, remedial investigation (RI) activities were conducted in five stages in order to characterize the nature and extent of contamination. A total of 29 shallow soil borings and nine subsurface soil borings were completed to characterize soil quality; two geophysical surveys were conducted to identify subsurface anomalies; and a total of eight shallow, six upper zone Castle Hayne, three intermediate zone Castle Hayne, and three deep zone Castle Hayne monitoring wells were installed. Five rounds of groundwater samples were collected from various monitoring wells and via "hydropunch" technique. Samples were analyzed for VOCs, semi-volatile organic compounds (SVOCs), pesticides, PCBs, inorganics, and CWM degradation compounds. The analytical results indicated that groundwater in the shallow aquifer as well as in the upper and intermediate portions of the Castle Hayne aquifer under the former disposal area have been impacted by VOCs (primarily 1,2-dichlorethene). Based on groundwater concentrations and the results of the geophysical survey, which identified metallic debris in the subsurface, the source of the VOCs appeared to be associated with buried waste near well cluster 69-GW15. However, the true location of source material remained unconfirmed due to the suspected presence of buried CWM. Surface water samples indicated that on-site ponded water in the southern portion of the site has been impacted with VOCs; however, off-site surface water and sediment samples indicated the New River, Everett Creek, and an unnamed tributary north of the site had not been impacted by site activities. Additionally, acetophenone, a CWM degradation compound, was detected in several surface soil samples, and on-site and drainage sediment samples. Michael Baker Jr., Inc. (Baker) concluded that the presence of acetophenone was attributable to training activities using "riot gas" (Baker, 1997).

In March 1996, a Treatability Study was conducted to evaluate the use of in-well aeration to remediate groundwater. The study deemed in-well aeration ineffective after two years of operation.

Long-Term Monitoring (LTM) of the site began in April 1998 on a semi-annual basis in order to fully assess plume stability and monitor seasonal changes. Groundwater samples are collected from eight monitoring wells screened in the surficial aquifer, six monitoring wells screened in the upper zone of the Castle Hayne aquifer, and one monitoring well screened in the deep zone of the Castle Hayne aquifer. Groundwater samples collected under this program are analyzed for VOCs and natural attenuation indicator parameters (NAIP).

In June 2000, an Interim Record of Decision (IROD) was issued to address the human health and ecological risks due to VOCs in groundwater and human safety risks due to buried CWM. Institutional controls and monitored natural attenuation (MNA) were the selected remedial actions, which are required to remain in effect until the remedial goals have been achieved or the IROD is superseded by a final Record of Decision (ROD). The remedial actions included: implementing a groundwater monitoring program targeting the VOCs of concern; conducting groundwater monitoring of inorganics and CWM degradation products in select wells; and implementing land use and aquifer use controls (shallow and Castle Hayne aquifers) to prevent site access, control intrusive activities, and prevent future use of the aquifers (Baker, 2000).

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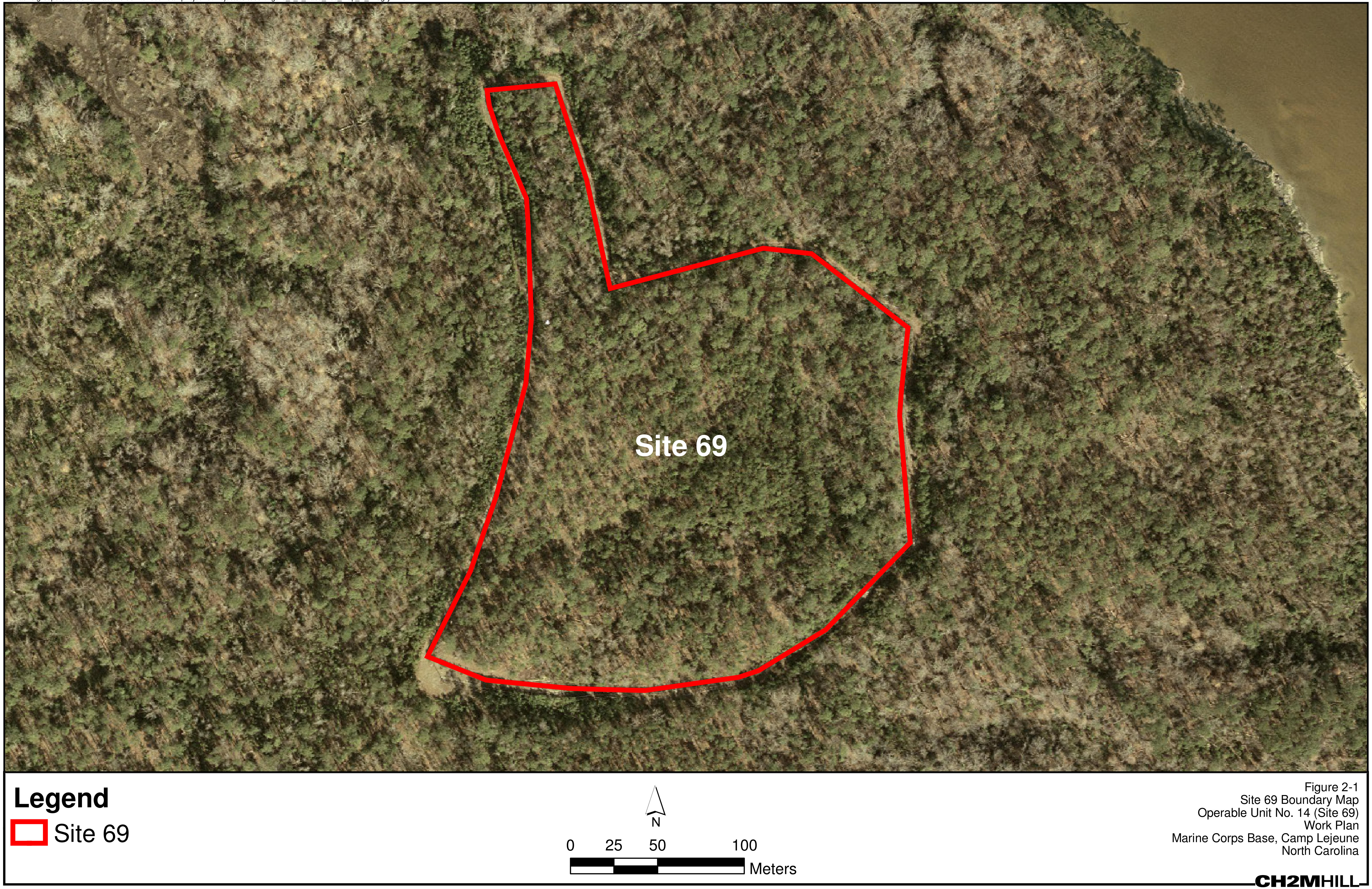

Figure 2-1
Site 69 Boundary Map
Operable Unit No. 14 (Site 69)
Work Plan
Marine Corps Base, Camp Lejeune
North Carolina

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SECTION 3

Data Quality and Sampling Objectives

The site-specific objectives presented in this section have been developed using the United States Environmental Protection Agency (USEPA) seven-step data quality objective (DQO) process, as presented in the USEPA *Guidance for the Data Quality Objectives Process* (USEPA, 2000a) and USEPA *Data Quality Objectives Process for Hazardous Waste Site Investigations* (USEPA, 2000b).

3.1 Data Quality Objectives Process

DQOs are qualitative and quantitative statements, developed using the USEPA DQO process, that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as a basis for establishing the quality and quantity of data needed to support decisions. DQOs define the performance criteria that limit the probabilities of making decision errors by considering the purpose of collecting data, defining the appropriate type of data needed, and specifying tolerable probabilities of making decision errors. The seven-step DQO process is as follows:

- Step 1 – State the Problem
- Step 2 – Identify the Decision
- Step 3 – Identify the Inputs to the Decision
- Step 4 – Define the Boundaries of the Study
- Step 5 – Develop a Decision Rule
- Step 6 – Specify Tolerable Limits on Decision Errors
- Step 7 – Optimize the Design for Obtaining Data

The following sections present the seven-step DQO process developed for the Supplemental Investigation at Site 69.

3.1.1 Step 1 – State the Problem

The first activity associated with this step is to establish the planning team. The planning team will include the North Carolina Department of Environment and Natural Resources (NCDENR), USEPA, Naval Facilities Engineering Command (NAVFAC) Atlantic Division, MCB Camp Lejeune, and CH2M HILL. These team members are decision-makers for the DQO process.

The planning team's primary goal is to determine the potential for future corrective action at Site 69. Specifically, the objectives of the Supplemental Investigation are as follows:

- Collect information to supplement and/or verify the environmental setting at the Site, including hydrogeology, geology, hydrology, topography, aquifer characteristics, and any other anthropogenic influences that may affect the hydrology or contaminant pathways at the site.

- Characterize the sources via the collection of analytical data, and evaluate the migration and dispersal characteristics of the release.
- Characterize the hazardous constituents (if any) via the collection of groundwater and soil samples in the vicinity of the Site. Characterization includes a definition of the extent, origin, direction and rate of movement of any contamination.
- Evaluate potential receptors by collecting data describing human populations and environmental systems susceptible to contaminant exposure.
- Evaluate the risk of any contaminants associated with the Site to human health and the environment.
- Provide recommendations for site management.

The problem is that Site 69 has not been adequately characterized and the extent of contamination has not been determined (i.e., a sufficient quantity of data does not exist to support a corrective action decision).

The final activity associated with this step is to identify available resources, constraints, and deadlines. The project team organization and project schedule are presented in Sections 5.0 and 6.0 of this Site-Specific Work Plan, respectively. The schedule presents the anticipated completion and/or submittal dates for specific tasks or documents.

3.1.2 Step 2 – Identify the Decision

The principal study question identified is:

- What is the nature and extent of contamination in the vicinity of Site 69?

Before a decision statement can be formulated, a definition of "contaminated" must be clarified. For the IR program, soil and groundwater will be considered "contaminated" if concentrations of contaminants of potential concern (COPCs) exceed the applicable North Carolina 2L Standards, NCDENR Soil-to-Groundwater screening criteria and/or USEPA Region IV Regional Screening Levels (RSLs) and the established background/secondary criteria (for metals only)(Baker 2001a, 2001b, 2002).

Considering the principal study question and definition of "contaminated," the decision statement is as follows:

- Define the nature and extent of contamination in the vicinity of Site 69 by determining whether or not the concentration of a given COPC at any given sampling point exceeds the regulatory driven criteria and established background/secondary criteria.

3.1.3 Step 3 – Identify the Inputs to the Decision

Existing information regarding the nature and extent of contamination in the vicinity of Site 69 comes from the previous RI performed by Baker. The results of these assessments are described in the *Final Site Assessment Report for Sites 6, 48 and 69* (ESE, 1992), the *Final Remedial Investigation* (Baker, 1997), and the *Annual Monitoring Report, Operable Unit 14 – Site 69* (Engineering & Environment, 2005). However, in order to determine the potential for future corrective action or additional actions, additional data is required to characterize and define the extent of contamination at the Site. The nature and extent of contaminated media, hydrogeologic characteristics, and the engineering properties of the site soils will be used to resolve the decision statement.

The criterion for determining the presence of contamination will be based on analytical results and applicable regulatory driven criteria and background/secondary criteria as described in Section 3.1.2. Samples will be analyzed for VOCs, SVOCs, Target Analyte List (TAL) metals, PCBs and pesticides using a fixed-based laboratory as described in Section 4.3.6.

3.1.4 Step 4 – Define the Boundaries of the Study

Groundwater, surface water, surface soil, subsurface soil, and sediment samples will be collected at the locations shown in **Figure 4-1**. The estimated depth of sampling ranges from 0 to 85 feet below ground surface (ft bgs).

Temporal changes in the extent of contamination are expected to be limited. Loss of contaminant mass does occur through natural attenuation processes (e.g., dilution, biodegradation, dispersion). As a result, data collection is not time dependent and the decision regarding the nature and extent of contamination will be based on existing conditions at the time of the investigation.

Practical constraints to sample collection are moderate to severe. The most severe issues exist during the installation of monitoring wells on the site. Given the land use history of the site (Section 2), health and safety considerations are the primary constraint. In addition, the area is remote, undeveloped, heavily wooded and surrounded by a chain-link fence. Weather conditions (such as heavy rain or lightning) can delay the field activities but are not a serious constraint.

3.1.5 Step 5 – Develop a Decision Rule

The decision rule developed for the Supplemental Investigation at Site 69 is as follows:

- If a given concentration at a given sampling point exceeds the regulatory driven criteria and background/secondary criteria for that contaminant, then that sampling point will be considered to be within an impacted area.

3.1.6 Step 6 – Specify Tolerable Limits on Decision Errors

Specification of tolerable limits on the decision errors will not be performed at this time. The sampling scheme is flexible and will include points inside and outside the suspected contaminant source area/plume so that the extent of contamination should be sufficiently defined. Specification of tolerable limits on the decision errors may be developed at a later date as determined by the planning team.

3.1.7 Step 7 – Optimize the Design for Obtaining Data

There are two fundamental goals for Step 7, and both rely on review of existing data and information:

- To evaluate the decision rule
- To design and optimize the sampling and analysis program

The decision rule developed in Step 5 has been shown to be valid following review of existing data. In this case, a simple statistical hypothesis test, broadly classified as a one-sample test was used. The test involved comparison of individual analytical data to a known value (regulatory driven criteria and established background/secondary criteria).

Existing information/data has been reviewed to evaluate and develop the data collection strategy for the field program. The referenced documents are the *Final Site Assessment Report for Sites 6, 48 and 69* (ESE, 1992), the *Final Remedial Investigation* (Baker, 1997), and the *Annual Monitoring Report, Operable Unit 14 – Site 69* (Engineering & Environment, 2005). In addition, the flexibility of the Site-Specific Work Plan optimizes resources in that the number and location of sampling points are determined by field conditions.

SECTION 4

Supplemental Investigation Tasks and Responsibilities

4.1 Project Management

Project management activities include such items as daily technical support and oversight; budget and schedule review and tracking; preparation and review of invoices; personnel resource planning and allocation; and coordination with NAVFAC, MCB Camp Lejeune, and subcontractors.

4.2 Subcontractor Procurement

This task includes procurement, scheduling and coordination of subcontractors. The primary subcontractors required for the Supplemental Investigation include drilling subcontractors, geophysical subcontractor, fixed-base analytical laboratory, independent data validator, utility locator and surveyor. Miscellaneous subcontractors may also be procured for various support services.

4.3 Field Activities

The Site 69 Supplemental Investigation field activities will include the following subtasks:

- Mobilization/demobilization
- Survey
- Vegetation clearance
- Geophysical investigation
- Surface water sampling
- Surface soil sampling
- Subsurface soil sampling
- Sediment sampling
- Monitoring well installation and development
- Monitoring well sampling
- Laboratory analytical program
- Quality Assurance/Quality Control (QA/QC)
- Sample preservation and handling
- Investigation-derived Waste (IDW) Management

The following subsections present a discussion of the proposed field activities.

4.3.1 Mobilization/Demobilization

Mobilization/demobilization consists of securing equipment and supplies necessary for the field activities and shipping or transporting those items both to and from the field. Travel time to and from the Base, construction of decontamination areas, location of IDW storage areas, field establishment of sampling locations, and underground utility clearance are also included under this task. MCB Camp Lejeune personnel will be consulted during mobilization efforts.

4.3.2 Survey

A North Carolina-licensed land surveyor will be retained to identify the various sampling locations, geophysical transects, and other site features. The sampling locations will be surveyed for topographic elevation relative to mean sea level (MSL) and horizontal position within the North Carolina State Plane Coordinate System. The vertical accuracy of the survey will be within 0.01 feet and the horizontal accuracy will be within 0.1 feet. Specific surveying procedures are presented in the Master Project Plan.

4.3.3 Vegetation Clearance

Vegetation will be cleared along several corridors ("transects") to facilitate the geophysical investigation described in Section 4.3.4 and the well installation tasks described in Section 4.3.9. Vegetation less than three inches in diameter will be removed from the area of investigation to allow site access for geophysical survey crews, sampling teams, and DPT equipment. Vegetation clearing will be accomplished using a combination of non-intrusive mechanical and manual methods. Trees greater than 3 inches in diameter will not be removed unless absolutely necessary.

The Base will coordinate with Camp Lejeune's Environmental Management Division office to identify federally protected species or archeological sites that may be encountered during vegetation clearing activities.

4.3.4 Geophysical Survey

Historical aerial photography for Site 69 indicates the presence of a cleared area located north of the current fenced area. In order to evaluate the potential for historical waste management practices in this area, a geophysical survey will be conducted using a G-858 magnetometer and an EM31 terrain conductivity meter. These instruments were selected for their ability to detect buried ferrous materials and variations in soil properties related to trenching, respectively. Geophysical survey transects will traverse the area of investigation using a separation of approximately 25 ft.

Geonics EM31 Terrain Conductivity Meter The Geonics EM31 is a non-intrusive frequency domain instrument used to map average variations of electrical conductivity at depths between 0 and 10 to 15 feet. Frequency domain instruments work by transmitting a sinusoidally varying electro-magnetic signal at one or more frequencies through a transmitter coil. A separate receiver coil measures a signal that is a function of the primary signal and the induced currents in the subsurface. The EM31 operates at a single frequency of 10 kilohertz (kHz), has an intercoil spacing of 12 ft and provides two measurements, quadrature (apparent conductivity) and in-phase (metallic response). One transmitter coil generates the EM energy and a second receiver coil detects EM fields caused by the transmitter as well as fields induced in subsurface conductive regions.

Geometrics G-858 The G-858 is an optically pumped cesium vapor instrument that measures the intensity of the earth's magnetic field in nanoTeslas (nT). During operation of the magnetometer, a direct current is used to generate a polarized monochromatic light. Absorption of the light occurs within the naturally precessing cesium atoms found in the instrument's two vapor cells. When absorption is complete, the precessing atoms become a transfer mechanism between light and a transverse radio-frequency (RF) field at a specific frequency of light known as the Larmor frequency. The light intensity is used to monitor the precession and adjusts the RF frequency allowing for the determination of the magnetic field intensity.

Anomalies in the earth's magnetic field are caused by remnant or induced magnetism. Remnant magnetism is caused by naturally occurring magnetic materials. Induced magnetic anomalies result from the induction of a secondary magnetic field in a ferromagnetic material by Earth's magnetic field. The shape and amplitude of an induced magnetic anomaly over a ferromagnetic object depend on the geometry, size, depth, and magnetic susceptibility of the object and on the magnitude and inclination of the earth's magnetic field in the study area. Induced magnetic anomalies over buried objects such as drums, pipes, tanks, and buried metallic debris and UXO generally exhibit an asymmetrical, south high/north low signature (maximum amplitude on the south side and minimum on the north).

4.3.5 Surface Water Sampling

Three surface water samples (designated as IR69-SW-01 through IR69-SW-03) will be collected at locations which correspond with previous monitoring locations. The locations of the proposed surface water samples are shown on **Figure 4-1**. Sample locations may be adjusted at the time of sampling based on site-specific conditions. Deviations from the proposed locations will be noted and explained in the Supplemental Investigation Report.

Care will be taken to minimize stirring up sediments during the collection process. General sampling procedures are presented in the Master Project Plans.

Samples will be analyzed by a fixed base laboratory for VOCs, SVOCs, TAL metals, pesticides, PCBs, and CWM degradation products.

4.3.6 Sediment Sampling

Three sediment samples (designated as IR69-SD01 through IR69-SD03) will be collected at locations which correspond with the surface water sample locations. The sediment sample locations are shown on **Figure 4-1**.

The samples will be collected at a depth of approximately 0 to 0.5 foot into the sediment using decontaminated stainless steel spoons/trowels or other appropriate sampling tools. General sampling procedures are presented in the Master Project Plans.

Samples will be analyzed by a fixed base laboratory for VOCs, SVOCs, TAL metals, pesticides, PCBs, and CWM degradation products.

4.3.7 Surface Soil Sampling

A total of six discrete surface soil samples will be collected from depths of 0 to 1 ft bgs at the locations shown on **Figure 4-1**. Actual sample locations will be surveyed by professional land surveyor at the conclusion of sampling activities.

Samples will be analyzed by a fixed base laboratory for VOCs, SVOCs, TAL metals, pesticides, PCBs, and CWM degradation products

4.3.8 Subsurface Soil Sampling

A direct push technology rig will be used to collect subsurface soil samples in accordance with the Master Project Plans. A total of six subsurface soil samples will be collected from just above the water table (estimated to range from 5 to 15 feet bgs) at the locations shown in **Figure 4-1**.

Subsurface soil samples will be analyzed by a fixed base laboratory for VOCs, SVOCs, TAL metals, pesticides, PCBs, and CWM degradation products.

4.3.9 Monitoring Well Installation and Development

A total of 15 monitoring wells will be installed to evaluate intermediate (50 to 55 ft bgs) and deep (80 to 85 ft bgs) portions of the aquifer. The new monitoring wells will be installed to complete the horizontal and vertical delineation of the contaminant plume in the intermediate and deep aquifer zones particularly in the central and northern portions as well as east of the fence line. It is anticipated that intermediate and deep zone wells will be installed adjacent to existing shallow aquifer wells 69-GW04, 69-GW05, 69-GW09, 69-GW10, and 69-GW11. However, the well locations may be adjusted based on information obtained during the geophysical investigation. If the geophysical data suggests evidence of potentially buried material north of the fence line, well clusters will also be installed north of the fence line to evaluate potential groundwater impacts in this area.

Additionally, the horizontal extent of VOCs in the Upper Castle Hayne aquifer has not been defined north and east of 69-GW13 and 69-GW13DW, therefore one deep aquifer well will be installed adjacent to 69-GW13DW. Two additional intermediate and deep well couplets will be installed east of 69-GW13 and northeast of 69-GW04. Existing and proposed monitoring well locations are shown on **Figure 4-1**.

In order to limit potential cross-contamination during construction, all wells will be constructed as 'Type III-equivalent' wells, utilizing rotosonic drilling equipment. The rotosonic drilling method will eliminate the need for permanent surface casings (required for mud or air rotary drilling), which significantly reduces the volume of IDW generated and allows completion of double and triple-cased wells in roughly one-third of the time required for traditional methods. The rotosonic method advances an isolation casing to prevent cross-contamination, the hole is grouted, and the casing is removed.

Well installation procedures are presented in the Master Project Plans and summarized below. All monitoring wells will be constructed using Schedule 40 PVC casing and five feet of 0.010-inch machine-slotted well screen. The annular space around the well screen will be backfilled with well-graded, fine sand as the rotosonic casings are being withdrawn from the borehole. The sand will extend to approximately two feet above the top of the screened interval. An approximately two-foot thick layer of bentonite pellets will be placed above the sand pack and hydrated with potable water, as necessary. The annular space above the bentonite seal will be backfilled with cement/bentonite grout to prevent surface water from infiltrating into the screened groundwater-monitoring zone. Above grade well covers will be installed at each well and surrounded by a concrete pad with protective bollards. All wells will have a water-tight, locking cap installed on the PVC riser. A padlock will be installed on each of the stick-up covers.

Each new well will be developed using pumping and surging methods. Typical limits placed on well development may include any of the following:

- A maximum time period (typically two hours)
- A maximum borehole volume (typically three to five borehole volumes plus the amount of any water added during the drilling or installation process)
- Stability of pH, specific conductance, and temperature measurements (typically less than 10 percent change between three successive measurements)
- Clarity based on turbidity measurements [typically less than 20 Nephelometric Turbidity Units (NTU)].

Well development procedures are detailed in the Master Project Plans.

4.3.10 Groundwater Sampling

All pre-existing wells and newly installed wells will be sampled. Monitoring well sampling will take place no sooner than two days after completion of well development. This will allow an adequate amount of time for the wells to equilibrate. The wells will be purged and sampled using peristaltic pumps and low-flow purging/sampling methods. If high volume/high yield wells are present, multiple pumps can be used. New disposable tubing will be used for each well. Specific sampling procedures are presented in the Master Project Plans and summarized below:

- The well cap will be removed and the ambient air above the well head will be screened in accordance with the HASP.

- The static water level will be measured, however, the total depth of the monitoring well will not be measured, to prevent the disturbance of sediment within the well casing. The total well depth will be obtained from the Well Construction Records. The water volume in the well will then be calculated.
- The sampling device intake will be slowly lowered until the bottom end is two to three feet below the top of the well screen or the top of the water level, whichever is greater. Next, the water level probe will be placed into the monitoring well just above the water.
- Purging will begin. The pumping rate will be set to create a sustainable flow (approximately 0.3 to 0.5 liters/minute) without causing a significant drop in water level in the well. The static water level will be periodically measured throughout purging to verify that a significant drop in water level has not occurred.
- Water quality parameters (WQPs), including pH, specific conductance, temperature, oxidation-reduction potential (ORP), turbidity, and dissolved oxygen will be measured frequently.
- Purging will be complete when three successive readings of pH, specific conductance, and temperature have stabilized within 10 percent (0.1 Standard Units for pH), turbidity is less than 10 NTUs, or there is no further discernable upward or downward trend. A minimum of one well volume will be removed from the well prior to sampling. If a well is purged dry, the well will be allowed to recharge (preferably to 70 percent of the static water level) prior to sampling.
- Upon WQP stabilization, groundwater samples will be collected and placed into the appropriate sample container(s).
- Samples will be analyzed by a fixed base laboratory for VOCs, SVOCs, TAL metals, pesticides, PCBs, CWM degradation products, and natural attenuation indicator parameters.

4.4 Field Quality Assurance/Quality Control

Specific QA/QC requirements are presented in the Master QAPP, which is contained in the Master Project Plans. The Master QAPP describes the different levels of sample analysis and the associated QC procedures required with each. Adherence to established USEPA chain-of-custody (COC) procedures during the collection, transport, and analysis of the samples will be maintained throughout the project. Laboratory analyses of the samples will conform to accepted QA requirements.

The following QA/QC samples will be collected during the field activities to ensure precision, accuracy, representativeness, completeness, and comparability:

- Equipment rinsate blanks
- Field blanks
- Field duplicates
- Matrix Spike/Matrix Spike Duplicates (MS/MSDs)

Equipment rinsate blanks will be collected by running laboratory-supplied de-ionized water over/through the sampling equipment and placing it into the appropriate sample containers for laboratory analyses. Equipment rinsate blanks will be collected from selected disposable sampling equipment (i.e., roll of tubing, stainless steel spoon, etc.); one equipment rinsate blank will be collected each day for reusable sampling equipment. The results will be used to verify that the sampling equipment has not contributed to contamination of the samples.

One field blank will be collected from each source of water used in decontamination. The field blanks will be collected by pouring the water from the original container or spigot directly into the sample bottle set. Field blanks will not be collected in dusty environments. The results will be used to verify that the water used in decontamination has not contributed to contamination of the samples.

Field duplicate samples will consist of one unique sample, split into two aliquots, and analyzed independently. Duplicate soil samples analyzed for parameters other than VOCs will be homogenized and split. Samples for VOC analyses will not be mixed, but select segments of the soil will be collected. Duplicate water samples will be collected simultaneously. The duplicate samples will be analyzed to verify the reproducibility of the laboratory results and degree of variability of reported concentrations. Duplicate samples will be collected at a frequency of 10 percent.

MS/MSD samples will be prepared in the field to address aliquoting reproducibility and to provide information on matrix reproducibility otherwise unobtainable from samples reported below analytically reproducible and statistically valid levels. MS/MSD samples will be prepared at a frequency of 5 percent for each group of samples of a similar matrix.

4.5 Sample Handling and Analysis

Samples for chemical analyses will be placed into laboratory-prepared sample containers with the appropriate preservatives and stored on ice in a cooler at 4° Celsius (or less) until shipped to the laboratory.

Sample preservation details are presented in the Master Project Plans. The type of container used for each sampling effort, as well as a summary of preservation requirements is described in the Master QAPP.

Proper COC documentation will be maintained for all samples from the time of collection until they are shipped to the analytical laboratory. The COC forms will contain the following information: project number (CTO), sampler names, sample numbers, number of containers, methods of preservation, date and time of sample collection, analysis requested, date and time of transportation to the laboratory, method of transportation, and any other information pertinent to the samples. Specific COC procedures are presented in the Master Project Plans.

Samples will either be hand delivered to the laboratory via courier or shipped via overnight courier.

4.6 Investigation-derived Waste Management

IDW will be managed in accordance with Section 4.20 of the Master Project Plans. IDW will consist of health and safety disposables, potentially contaminated soil, decontamination fluids, and groundwater. Health and safety disposables, such as sampling gloves, and soil IDW generated as part of the field activities will be separately containerized in Department of Transportation (DOT) approved 55-gallon drums or in roll-off containers. Water IDW will be placed in poly tanks or 55-gallon drums. The IDW containers will be transported to and staged at a designated 90-day storage area pending final disposition.

4.7 Data Management and Validation

It is anticipated that data management activities will consist primarily of entering field and laboratory data onto computerized spreadsheets using database software and tabulating field and analytical results for preparation of the report.

An independent data validator will be subcontracted for data validation. The laboratory analytical results will be evaluated to assess the technical adequacy and usability of the data. The data will be technically reviewed based on specifications set forth in the Naval Energy and Environmental Support Activity (NEESA) and USEPA guidance documents.

4.8 Data Evaluation

This task involves efforts related to the data once it is received from the laboratory and is validated. In addition, this task involves the evaluation of field-generated data including laboratory analytical data, water level measurements, Test Boring and Well Construction Records, water quality measurements, and other field notes. Efforts under this task will include the tabulation of validated analytical data and field data; generation of Test Boring and Well Construction Records; and generation of groundwater contour maps and other diagrams/figures/tables associated with field notes or data received from the laboratory (e.g., sampling location maps).

The laboratory analytical results will be compared to the North Carolina 2L standards, NCDENR Soil-to-Groundwater screening criteria, and/or USEPA Region IX PRGs and the established base background/secondary criteria.

4.9 Risk Assessment

The Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA) will be re-evaluated with the addition of samples collected during this Supplemental Investigation at Site 69. The HHRA and ERA will identify existing or potential risks that may be posed to human health and/or the environment and will serve to support the evaluation of the threats posed by a site with respect to current and future potential exposure scenarios. In addition, the HHRA and ERA will be used to support development and evaluation of remedial alternatives during the Feasibility Study (FS). The general approach for conducting the HHRA and ERA is presented in the Master Project Plans and summarized in the following subsections.

4.9.1 Human Health Assessment

The re-evaluated HHRA will be conducted in accordance with the *National Oil and Hazardous Substances Pollution Contingency Plan (NCP)* (USEPA, 1990). The primary guidance document for the HHRA will be the *Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A) Interim Final* (USEPA, 1989). USEPA Region IV will be consulted for Federal guidance and the NCDENR will be consulted for guidance in the State of North Carolina.

The technical components of the HHRA will include contaminant identification, exposure assessment, toxicity assessment, and risk characterization. The objectives of the risk assessment process are as follows:

- Characterize the toxicity and levels of COPCs in relevant media (e.g., soil, groundwater, surface water, sediment, air, and biota).
- Characterize the environmental fate and transport mechanisms within specific environmental media.
- Identify potential current and future human receptors.
- Identify potential exposure routes and the extent of the actual or expected exposure.
- Define the extent of the expected impact or threat.
- Identify the levels of uncertainty associated with the above items.

The HHRA will utilize all available data to date that has been properly validated in accordance with USEPA guidelines plus data that is collected and validated from additional sampling during the Supplemental Investigation.

4.9.2 Ecological Assessment

The ERA will be conducted to evaluate the likelihood that adverse ecological effects would occur or are occurring as a result of exposure to one or more physical or chemical stressors. The assessment will evaluate the potential effects of chemicals on terrestrial and aquatic receptors (e.g., flora and fauna) and their habitats, including the consideration of protected species and sensitive or critical habitats and will identify particular chemical stressors that may cause adverse effects.

The ERA will be conducted according to guidance provided by the USEPA and NCDENR.

4.10 Report Preparation

A Supplemental Investigation Report will be prepared following the general format as presented in USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final* (USEPA, 1998) and will include, but not be limited to, the following:

- Information to supplement and/or verify the environmental setting of the site including geology and hydrogeology
- A summary of the investigation/sampling activities
- Characterization of the source(s)
- Evaluation of the nature and extent of contamination
- Human health and ecological risk assessments

- Conclusions and recommendations

A draft report will be submitted to the USEPA and NCDENR for comments and approval. Response to comments and necessary revisions will be made to the revised draft report before issuing a final report.

4.11 Meetings

This task includes participation in project meetings to be held between members of the project team. Meetings will be held before and after completion of the field activities; one meeting will be held after submission of the draft report. The purpose of the meetings will be to discuss the field activities and sampling results/findings.

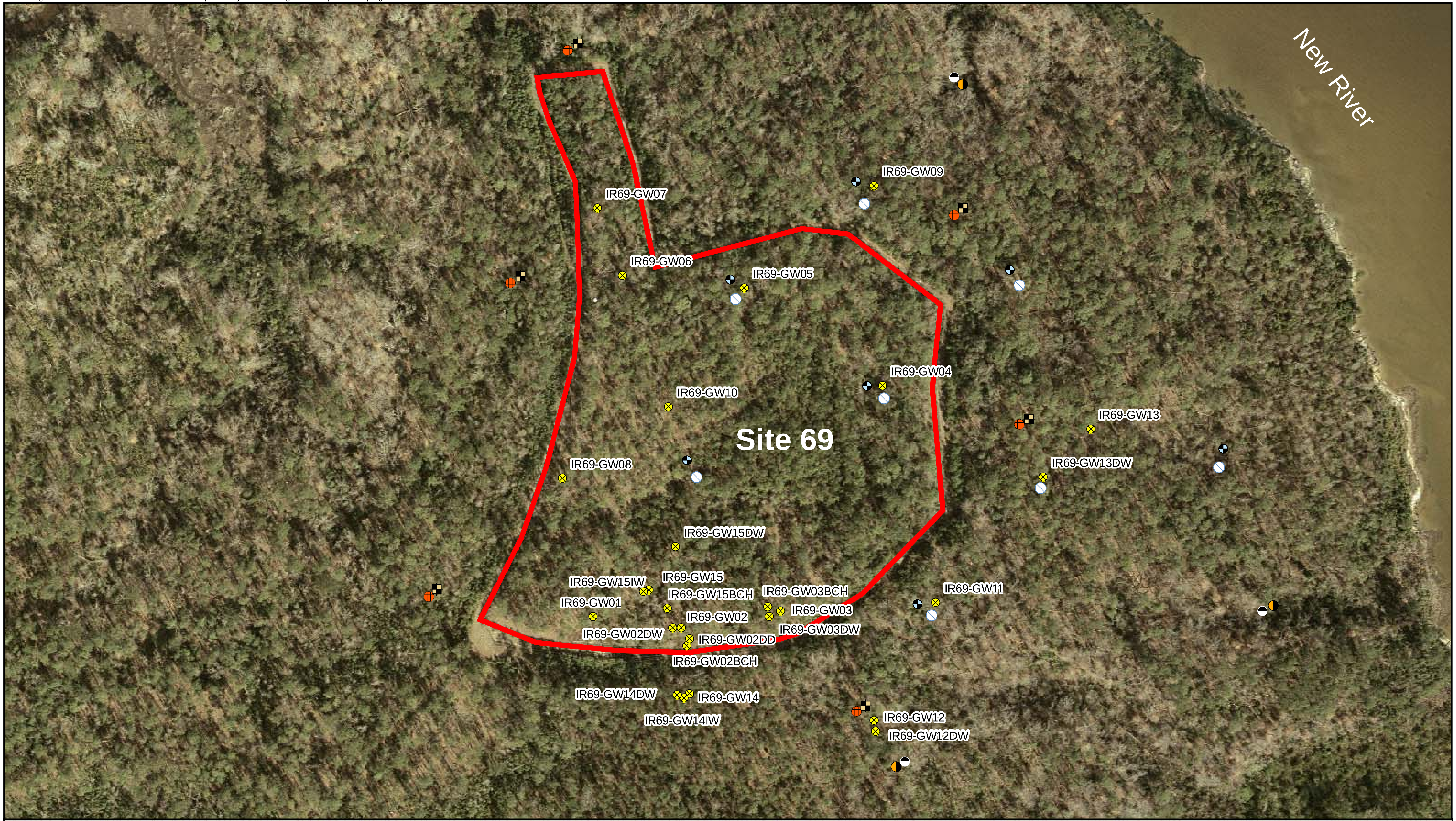
TABLE 4-1
Sample Analysis Summary - OU-14, Site 69
Supplemental Investigation, CTO - 0105
MCB, Camp Lejeune, North Carolina

Sample Type	Sample Designation	Soil Samples	Water Samples	
			Schedule A	Schedule B
Surface Water	IR69-SW01 through IR69-SW-06		6	
	SUBTOTAL	**0**	**6**	**0**
Sediment	IR69-SD01 through IR69-SD06	6		
	SUBTOTAL	**6**		
Surface and Subsurface Soil	IR69-SS001 through IR69-SS006	6		
	IR69-SB001 through IR69-SB006	6		
	SUBTOTAL	**6**	**0**	**0**
Groundwater	28 existing + 14 newly installed wells		42	42
	SUBTOTAL		**42**	**42**
Total Environmental Samples		**12**	**48**	**42**
Trip Blanks		0	6	0
Field duplicate samples		1	5	5
Matrix Spike Samples (MS)		1	2	0
Matrix Spike Duplicate Samples (MSD)		1	2	0
Field Blanks		1	6	6
Equipment Rinsate Blanks		1	6	6
	TOTAL SAMPLES	**17**	**75**	**59**

Schedule A VOCs, SVOCs, Pesticides, PCBs, CWM degradation products

Schedule B Natural attenuation indicator parameters

\\Ariadne\groups\GIS\USNavFaceNGCom\315007CampLejeune\Projects\Site69\Figure 4-1 Proposed Sampling Locations.mxd



Proposed Sampling Locations:
- Sediment
- Subsurface Soil
- Surface Soil
- Surface Water

Proposed Monitoring Wells:
- Deep
- Intermediate

Existing Wells:
- Phase I Remedial Investigation Well

N

0 200 400 Feet

Figure 4-1
Proposed Sampling Locations
Operable Unit 14 (Site 69)
MCB Camp Lejeune, North Carolina

CH2MHILL

SECTION 5

Project Management and Staffing

CH2M Hill's primary participants for this project (CTO-0223) are as follows:

- Mr. Matt Louth – Activity Coordinator
- Ms. Theron Grim – Project Manager
  Task Managers

Mr. Grim and the Task Managers will have the overall responsibility for conducting the field activities and completing the reports associated with this CTO. They will be supported by geologists, engineers, scientists, biologists, and clerical personnel, as needed. The Task Managers will report to Mr. Grim and Mr. Louth who will then relay pertinent issues and maintain close contact with NAVFAC and the Base.

SECTION 6

Project Schedule

The project schedule is presented in **Figure 6-1**. The schedule presents the anticipated completion and/or submittal dates for specific tasks or documents.

FIGURE 6-1
Proposed Project Schedule - OU14, Site 69

Task Name	Duration (days)
Supplemental Investigation Field Work	26
Laboratory Analysis/Data Validation	45
Draft Supplemental Investigation Report	90
Agency Review	40
Final Supplemental Investigation Report	30

SECTION 7

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